

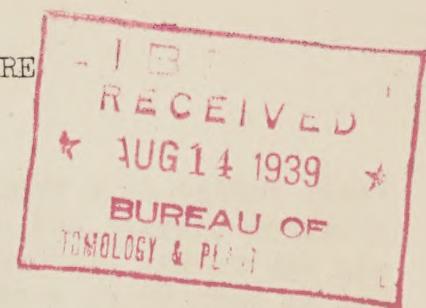
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UNITED STATES DEPARTMENT OF AGRICULTURE
BUREAU OF ENTOMOLOGY
FOREST INSECT INVESTIGATIONS

CIRCULAR OF INFORMATION
ON
CONTROL OF WESTERN PINE BEETLE.



One of the most serious enemies of ponderosa pine is a small insect known as the western pine beetle, (*Dendroctonus brèvicomis* Lec.) Every year throughout the entire range of ponderosa pine from lower California to British Columbia thousands upon thousands of the largest and finest of these pines fall as victims to these tiny insects. The total destruction measured in board feet or in dollars is enormous. However, much of this is only the normal loss since in any one locality not more than one-third to one-half of one percent of the stand is killed in any year. But frequently, in some locality particularly favorable to the beetles, they build up their numbers until hundreds of trees in every square mile are destroyed. And in one year, as much as ten per cent of the stand may be killed. Such a situation is called epidemic and calls for action on the part of the timber owner if he values his timber crop at all highly, and wishes to save as much as he can of it from destruction.

What It Is:

To the ordinary observer, the western pine beetle appears to be a small, brown to black, cylindrical, rather stout beetle with a body somewhat smaller than the ordinary house fly. The larvae of the beetle are small, white legless grubs about $\frac{1}{4}$ of an inch long with a small yellow head. They may be found by slicing half way through the bark of an infested pine, and if the tree is at all heavily infested, will scatter out like so many grains of rice.

What It Does:

Boring through the bark, the beetles kill the trees by gnawing tunnels thru the cambium layer, completely girdling them and thus cutting off the tree's sap. Besides attacking and killing standing green trees, it breeds to some extent in windfalls, broken or injured trees, and in the butts and cull logs left from logging operations or in the main trunk of trees felled in other types of cutting.

It confines its attack to the ponderosa pine, (and also Coulter pine in southern California) and to the main trunk of the attacked trees. Rarely does it go into tops less than six inches in diameter, or into the limbs.

How to Recognize Its Work:

Usually the first evidence that a tree has been attacked by these beetles is the sickly pale color of the needles. The faded appearance gradually changes to a yellow or sorrel and then to a bright red. In the

first fading of a tree, the needles die from the center of the needle clusters outward and usually from the top of the tree downward. During the normal process of shedding the old needles a tree sometimes has so many dying needles that it resembles an infested tree altho it may be perfectly healthy. However, it will be noted that on these healthy trees, the center of the needle clusters at the tip of the branches are green, while an infested tree is characterized by the dead tips with possibly green needles further back on the branches.

On closer examination of the infested tree, small circular holes about 1/16 of an inch in diameter, will be noticed in the bark, usually in the crevices. A very small amount of sawdust will be found in some cases, and occasionally pitch tubes cover the holes through which the beetles forced their entry into the tree. Upon chopping into the suspected tree so as to expose the sap wood and inner surface of the bark, the winding egg-galleries will be found in the inner bark. These egg-galleries, which are slightly larger in diameter than the beetle, are filled with sawdust and cross and recross each other in such a manner as to form a network of irregular lines. This peculiar type of egg-gallery is characteristic of the species and can be said to be the hieroglyphic or signature of the western pine beetle.

If the tree has just recently been attacked, the bark will still be tight on the sapwood, not discolored, and the fresh dark-brown beetles will be found in the galleries with small white eggs about the size of a pin point deposited in little niches on the walls of the gallery. Sometime after the attack, the inner bark withers, becomes discolored and brown and loosens from the tree. At this stage the parent beetles will be found at the end of the egg-galleries where they finally die.

After the eggs have hatched, the small worms burrow for a short distance in the inner bark where they reach maturity, transform to the pupae or resting stage and then change to new beetles. These new beetles are at first very light in color but gradually they darken as their shell hardens. Soon they are ready to emerge and to attack other trees.

On leaving the tree each beetle burrows out for himself leaving a neat round exit hole in the bark, so that the tree from which many beetles have escaped looks as though it had been peppered with bird shot. Trees in this condition should never be felled or burned as the destructive pine beetles have already escaped and only the predatory insects which prey upon them and leave the tree after the emergence of the beetles, will be destroyed.

Its Seasonal Development:

The western pine beetles develop and work so rapidly that trees which are attacked in the early summer are killed and abandoned before fall and their progeny are at work on other trees which are killed before winter. It is in these later attacked trees that the beetles spend the winter in a semi-dormant condition.

After emergence from the dead trees the new beetles enter a period of flight, after which they concentrate upon certain trees to which they are attracted and start their attacks. The first attacks on a healthy tree usually start near the top and the beetles keep coming in numbers for a period of several days or a week until the natural resistance of the sap flow of the tree has been overcome and the girdling of the tree by the egg-galleries has been completed. A successful attack requires about 24 parent adults to a square foot of bark or about 7,000 beetles to a 24 inch 5-log tree.

Within a week or two after the attack, the tree dies. The parents mine their egg-galleries and deposit eggs which hatch in about 7 days. The grubs feed upon the sap of the dead tree, complete their growth, change to pupae, then to new adults and finally the new broods leave the tree. These new broods emerge from the summer-killed trees during August, September and October. From actual counts, it has been found that enough new beetles are hatched from a single infested tree to kill eleven other trees provided all beetles made successful attacks. However, many of the beetles which emerge are lost during the flight period, are killed by predators, or are drowned out by the sap flow in trees which they do not attack in sufficient numbers to overcome. This mortality of the beetles accounts for the occasional natural control of epidemics and the consequent failure of the beetles to increase for a period of years.

The beetles which emerge from so-called "summer trees" attack and kill new trees during September, October and November. After the attack, eggs are laid and the development of the brood continues until it is stopped by the cold winter weather. The insects then pass the winter in all stages of development, namely as parent adults, eggs, larvae and occasionally pupae and new adults. They renew their activity and development again in the spring with the advent of the first warm weather.

It is during the late fall, winter and early spring period when the beetles and grubs are still in the bark of the trees that the greatest good can be accomplished thru control measures.

How They are Regulated Under Natural Conditions:

Under natural conditions, the western pine beetle has many enemies such as parasitic and predaceous insects, mites, bacterial and fungoid diseases, and birds.

One of the most important enemies of the beetles are the woodpeckers. They will be seen hammering away on the "bug trees" during the fall, winter and spring and succeed in devouring great quantities of the grubs. Sometimes a heavily infested tree is almost stripped of bark by the woodpeckers in their search for grubs.

There are also two species of beetles which devour great numbers of the adult pine beetle before they can bore into the bark to protect themselves. One of these, a Clerid, (*Thanasimus nigriventris*) is a grey beetle about three eighths of an inch long. They may be seen on warm days running actively over the bark of trees which are being attacked by the pine beetles. These predators are attracted to the tree by the attacks of the first beetles, and they seem to have the habit of lying in wait for the beetles as they come to the tree. Another common benefactor is an Ostromid, a bright metallic green or bluish green and somewhat flattened beetle equipped with strong pinchers. The larvae of both the Clerid and Ostromid live under the bark and feed on the immature stages of the pine beetle.

Thru the operation of what is known as the law of the balance in nature, when the western pine beetle increases and becomes epidemic, their enemies wax fat and prosperous due to increased food supply, until they become so abundant that they outweigh the pine beetles. The pine beetles then are reduced until the predators die off for lack of food, and then the cycle is repeated. This, together with many other factors such as unfavorable climatic conditions helps to explain the periodicity of the pine beetle epidemics.

In the long run the beetles do not completely destroy the forests, for it is practically certain, that they have always been present in the forest, but they can so seriously reduce the mature timber crop that it may take several decades for the forest to regain the loss in volume.

How the Beetles can be Artificially Controlled:

In order to prevent the great destruction of commercial timber, by these beetles, and more quickly restore the balance in nature, the Bureau of Entomology has devised certain methods of control.

The two principal methods which have been used to destroy the infesting broods are the burning and the sun curing methods. These methods are best applied in the late fall, winter or early spring during the period of beetle activity.

The Burning Method: The burning method consists of felling the infested trees, peeling the bark from the top half of the log well down on the sides, and as far along the log as it is infested, piling this bark alongside of the log and then burning it. Trees should be felled, when possible, away from standing trees or reproduction. To make a clean job, the limbs are removed, the top lopped off and brought back over the log, the limbs piled on top and all of this debris burned. Late in the spring

season when the forest becomes dry it is safer to pile the brush away from the tree and make a fire line around the log. By varying the amount of material left on and around the log, and the width of the fire line, burning can be carried out at any time of the year and during the driest weather with perfect safety. When the bark is wet with snow or rain it is necessary to cut pitch and other dry material to lay along the log in order to get heat enough to insure a good burn.

Small trees, if in groups, are usually cut, bucked up and piled together and the entire pile burned. This is much cheaper than attempting to peel them. In this case, the fire is usually hot enough to consume all of the limbs and main stem. On the larger trees only the bark is burned and the peeled log is simply scorched, and can be used later for lumber provided it is removed from the forest within two years. Trees which have been peeled and scorched do not deteriorate as rapidly as those which are left standing with the bark attached. So that, while control work appears to be a very destructive operation, nature's own processes are even more so.

The Sun Curing Method: A few years ago the discovery was made, that if bark infested with the western pine beetle was peeled from the trees and laid so as to receive the direct rays of the sun, the beetles would be killed by the excessive temperatures produced.

This method, therefore, gained favor as a summer method of control when the cost of necessary fire precautions became excessive.

In using this method, the attempt is made to fell the trees so that most of the infested trunk is off of the ground. The tree is then limbed and the brush piled at least 10 feet away from the tree so as to give a space in which to spread the bark. All of the infested bark is then peeled and spread on the open ground, (either side up) where it will get the direct rays of the sun for at least two hours during the middle of the day. In case the tree has not been bedded so that all of the underside may be reached in peeling, the log should be rolled so that the bark of the under side may be removed.

However, in the practical application of this method, difficulties were encountered. Slope, exposure, denseness of forest cover, brush, cloudy weather and many other factors made the effectiveness of the method an uncertain quantity, so that, it is no longer used on any extensive scale.

Trap Trees: Trap trees as a means of localizing infestation and simplifying control have often been advocated. After extensive tests on the San Joaquin project in California, the conclusion has been reached, that "trap trees" fail to trap infestation in sufficient quantity to protect the surrounding forest. Their use, therefore, as a means of control is not advocated, unless the timber can be utilized.

Control Through Logging: Although control through logging has only been used to a very limited extent, it offers the advantage of helping to pay the cost of control through the sale of the salvaged timber.

To destroy the beetles, the infested trees should be either removed to a mill several miles from the forest or the logs placed in the mill pond and left for more than six weeks, or the logs cut into lumber and the slabs burned before the broods emerge.

This method could be applied in many different ways, such as in combination with the sale of a limited amount of green mature timber, with cuttings carried on as purely a control measure during the summer, closing at the beginning of beetle activity. It could only be profitably applied on a unit reasonably close to a saw mill, or where the topography did not preclude the use of a portable mill.

It has been noted that cutting operations are very attractive to the beetles, so that where the infestation is removed with the logs for a season or two a greater reduction of infestation in the general vicinity is brought about than by any other control method.

When Should Artificial Control Be Undertaken?

The results of recent experiments indicate that it does not pay to attempt to control or reduce normal infestation. The balance in Nature is adjusted to provide for a certain amount of insect loss each year and attempts to avoid this loss may so upset the natural balance as to precipitate an epidemic.

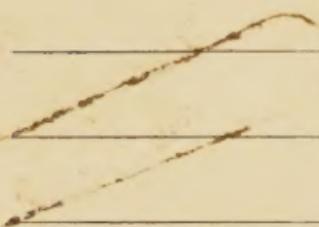
If, however, a careful examination indicates that the beetles are rapidly advancing to or have reached epidemic proportions, then artificial control should be resorted to provided:-

1. That the timber values at stake, either from the commercial, recreational or aesthetic standpoint, warrant the cost of control measures.
2. That the cooperation can be secured, of all owners in the affected territory so that an entire basin or natural topographic unit can be included in the control program.
3. And that control measures can be applied on a scale extensive and thorough enough to insure success, which will require:

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Circular of information on control of
western pine beetle. By F.P. Keen, Jan. 1932.



- (a) That on small, well isolated areas the entire infestation be treated in one season; or
- (b) That on larger units with partial isolation, one season's treatment will be followed by maintenance control or will be logged within three or four years; or
- (c) That on large commercial holdings, isolated or not, control work can be accomplished through selective logging and salvage at a very low cost or at a small profit.

To be effective, the control work should remove as near one hundred percent of the overwintering infestation within the treated area as is physically possible, and should extend to the natural boundaries of the ponderosa pine type or to one mile or more beyond the edges of the area under protection. Western pine beetle broods from contiguous infested timber can be expected to work back into the treated area at the rate of about one-half mile to each generation or about one mile per year in the central part of its range.

What are the Chances of Success?

So far wherever artificial control measures have been applied to epidemic infestations they have been successful in reducing the infestation and have helped to restore the balance in nature. Where timber values have been high, the amount of timber saved has more than offset the cost of the work.

On the whole, artificial control work against the western pine beetle can be looked upon as a profitable form of timber insurance.

Other Similar Insects in ponderosa pine.

There are several other insects which are found in ponderosa pine which are often confused with the western pine beetle. Some of the more common ones are:

The Mountain Pine Beetle (Dendroctonus monticolae, Hopk.) is a larger beetle than the western pine beetle, is black in color and is found not only in ponderosa pine but in sugar pine, lodgepole pine, white pine, etc. Its egg-galleries run straight up and down the tree and the larval galleries run at right angles to the egg-galleries. The larval galleries are much more conspicuous than the larval galleries of the western pine beetle. The pupae form cells in the inner bark and usually the larvae, pupae, or new adults can be seen by simply removing the bark without slicing it. In ponderosa pine this beetle will usually be found in the smaller trees, less than 20 inches in diameter. It is a serious enemy of pines and should be regarded as a primary insect.

The Turpentine Beetle (Dendroctonus valens, Lec) is a large red beetle of the same general shape as the western pine beetle and is found usually in the base of the infested trees and in stumps. The larvae feed in masses between the bark and wood and the pitch tubes near the base of the tree are always conspicuous.

The Engraver Beetles (Ips confusus and Ips oregoni) are small, brown cylindrical beetles without visible hairs and are easily distinguished by their peculiar rear end which appears as though a chunk had been bitten out of the top side. They can also be distinguished from the western pine beetle by the character of their egg-galleries which are free from sawdust and with conspicuous egg niches. The beetles are often encountered in the tops of trees killed by the western pine beetle, in limbs and down logs, and in polo stands of young trees.

The Large Engraver Beetle (Ips emarginatus) is about the size of the mountain pine beetle but can be distinguished from it by the clytral notch on its rear end. Its work can also be distinguished from the western pine beetle as the egg-galleries are clear of sawdust while the western pine beetle galleries are packed with this material. This species is occasionally found in ponderosa pine trees infested by the western pine beetle.

The Hylurgops Beetle (Hylurgops subcostulatus) is a beetle very similar in appearance to the western pine beetle except that it is slightly longer, of a duller color and of a rougher texture. It is usually found under the bark of sour-sap trees. The beetle makes no definite egg-galleries, a characteristic which distinguishes its work from that of the western pine beetle.

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